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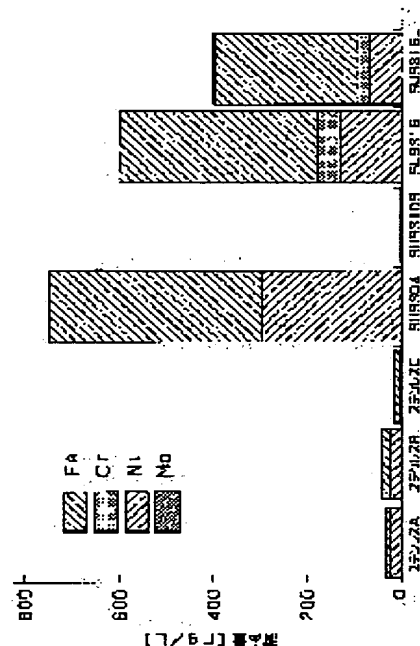
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(54) POLYMER ELECTROLYTE FUEL CELL

(57)Abstract:

PROBLEM TO BE SOLVED: To prevent the corrosion being generated when the conductive separator, which is a constituent of a polymer electrolyte fuel cell, is made of stainless steel.

SOLUTION: A ferritic or austenitic stainless steel, which defines the content of carbon or content of nitrogen, is used.



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CLAIMS

[Claim(s)]

[Claim 1] The cell possessing a hydrogen ion conductive polymer electrolyte membrane and the electrode of the pair arranged in the location which sandwiches said hydrogen ion conductive polymer film In the polyelectrolyte mold fuel cell which carried out supply discharge of the fuel gas which contains hydrogen in one side of said electrode, and carried out the laminating through the conductive separator in which the gas circulation way which carries out supply discharge of the oxidizer gas containing oxygen was formed on another side The polyelectrolyte mold fuel cell characterized by constituting said conductive separator from the ferrite system or the austenite stainless steel plate with which a carbonaceous content does not exceed 0.03 % of the weight.

[Claim 2] A stainless steel plate is a polyelectrolyte mold fuel cell according to claim 1 characterized by being 1.5 % of the weight or more, and containing Mo 8 or less % of the weight.

[Claim 3] The cell possessing a hydrogen ion conductive polymer electrolyte membrane and the electrode of the pair arranged in the location which sandwiches said hydrogen ion conductive polymer film In the polyelectrolyte mold fuel cell which carried out supply discharge of the fuel gas which contains hydrogen in one side of said electrode, and carried out the laminating through the conductive separator in which the gas circulation way which carries out supply discharge of the oxidizer gas containing oxygen was formed on another side The polyelectrolyte mold fuel cell which a carbonaceous content does not exceed 0.03 % of the weight for said conductive separator, but the content of nitrogen is 0.1 % of the weight or more, and is characterized by constituting from 0.3 or less % of the weight of an austenitic-stainless-steel plate.

[Claim 4] a stainless steel plate -- Cr -- 18.5 % of the weight or more -- and 23 or less % of the weight and nickel -- 12 % of the weight or more -- and 20 or less % of the weight and Mo -- 1.5 % of the weight or more -- and the polyelectrolyte mold fuel cell according to claim 3 characterized by containing 8 or less % of the weight.

[Claim 5] The polyelectrolyte mold fuel cell according to claim 4 which is 0.05 % of the weight or more, and is characterized by adding 0.2 or less % of the weight of Cu at a stainless steel plate.

[Claim 6] The cell possessing a hydrogen ion conductive polymer electrolyte membrane and the electrode of the pair arranged in the location which sandwiches said hydrogen ion conductive polymer film In the polyelectrolyte mold fuel cell which carried out supply discharge of the fuel gas which contains hydrogen in one side of said electrode, and carried out the laminating through the conductive separator in which the gas circulation way which carries out supply discharge of the oxidizer gas containing oxygen was formed on another side The polyelectrolyte mold fuel cell characterized by constituting said conductive separator from a ferritic-stainless-steel plate which is 18.5 % of the weight or more, and contained Cr 23 or less % of the weight.

[Claim 7] A stainless steel plate is a polyelectrolyte mold fuel cell according to claim 6 characterized by for a carbonaceous content not exceeding 0.015 % of the weight, and the content of nitrogen not exceeding 0.015 % of the weight.

[Claim 8] A stainless steel plate is a polyelectrolyte mold fuel cell according to claim 1 to 7 characterized by adding Ti or Nb so that $X+Y \geq 8 (Z+W)$, however X, Y, Z and W may become [show weight % of Ti, Nb, carbon, and nitrogen, respectively].

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] this invention — the power source for a portable power source and electric vehicles, and domestic — cogeneration — it is related with the polyelectrolyte mold fuel cell of the ordinary temperature actuation mold used for a system etc.

[0002]

[Description of the Prior Art] A polyelectrolyte mold fuel cell is made to react electrochemically, and makes coincidence generate the electrical and electric equipment and heat with the gas diffusion electrode which has arranged catalyst beds, such as platinum, for fuel gas, such as hydrogen, and oxidation gas, such as air. The general configuration of such a polyelectrolyte fuel cell was shown in drawing 1.

[0003] In drawing 1, the catalytic-reaction layer 12 which uses as a principal component the carbon powder which supported the metal catalyst of a platinum system is stuck and arranged in both sides of the polyelectrolyte film 11 to which a hydrogen ion is conveyed alternatively. Furthermore, in the external surface of a catalyst bed 12, the diffusion layer 13 of a pair which combines gas permeability and conductivity is stuck to this, and is arranged. This diffusion layer 13 and the catalytic-reaction layer 12 constitute an electrode 14. While fixing mechanically the electrode electrolyte membrane zygote (following, MEA) 15 formed in the outside of an electrode 14 by the electrode 14 and the polyelectrolyte film 11, the conductive separator plate 17 in which the gas passageway 16 for carrying away the gas of the water which connected adjoining MEA(s) to the serial electrically mutually, and supplied reactant gas to the electrode further, and was generated by the reaction, or a surplus was formed to one field is arranged.

[0004] Although a gas passageway can also be prepared apart from a separator plate, the method which establishes a slot in the front face of a separator plate, and is made into a gas passageway is common. In the still more above polyelectrolyte mold fuel cell stacks, in order to reduce electric contact resistance with configuration members, such as a separator plate, and in order to maintain the seal nature of fuel gas or oxidizer gas, it is required to bind the whole cell stack tight constantly. For that, it is effective to arrange an end plate to those both ends that accumulated many cells on the one direction, respectively, to fix and bind between both that end plate tight using the member for conclusion, and to apply **.

[0005] Moreover, since a fuel cell generates heat during operation, in order to maintain a cell in the good temperature condition, it is necessary to cool with cooling media, such as cooling water. Usually, although the cooling section which pours a cooling medium every one to 3 cel is inserted between separators, cooling-medium passage is established in the tooth back of a separator, and it considers as the cooling section in many cases. After it piles up these MEA(s) and separators, and the cooling section by turns and they carry out two or more cel laminating, it is the structure of a common layer built cell which this is inserted with an end plate and fixed from both ends with a conclusion bolt through a collecting electrode plate and an electric insulating plate.

[0006] Such a separator plate of a polymer electrolyte fuel cell has high conductivity, and to distributed gas, its gas airtightness is high and it needs to have high corrosion resistance and

chemical stability to the environment in a fuel cell stack further. Therefore, the conventional separator plate was constituted from carbon ingredients, such as glassy carbon and expanded graphite, and, cutting in the front face, and in the case of expanded graphite, the gas passageway was also created by molding with a mold.

[0007] However, it replaces with the carbon ingredient used conventionally, and the attempt using metal plates, such as stainless steel, is made in recent years.

[0008]

[Problem(s) to be Solved by the Invention] If a carbon ingredient is used for a separator plate like before, for maintenance of gas airtightness and a mechanical strength, there will be a limitation by making 4mm in thickness into a minimum in general to thin-shape-izing of a separator plate, and to become a failure about mount nature will be considered by the miniaturization pan of a cell stack.

[0009] Furthermore, by the approach by cutting of the conventional carbon plate, it is difficult with the ingredient cost of a carbon plate to reduce the processing cost for cutting this, and the approach using expanded graphite also has high ingredient cost, and is considered to be a failure for utilization. It is very effective to constitute a separator plate from metallic materials, such as stainless steel, to miniaturization of a separator plate, low-cost-izing, and high-intensity-izing. However, by the approach using a metallic material, corrosion and the dissolution of a metal plate take place by operation of long duration. If a metal separator corrodes, the electric resistance of a corrosion part and electric contact resistance will increase, and a cell output will decline.

[0010] Moreover, if a metallicity separator dissolves, the dissolved metal ion will mix in MEA, a trap will be carried out to the ion-exchange site of a polyelectrolyte, the own fall of ion conductivity of a polyelectrolyte and the fall of electrode reaction area will be caused, and a cell output will decline. The technical problem that generating efficiency fell gradually according to these causes about carrying out long duration operation of the polyelectrolyte mold fuel cell using the metal separator which is not equipped with sufficient corrosion resistance occurred.

[0011]

[Means for Solving the Problem] In order to solve such a technical problem the polyelectrolyte mold fuel cell of this invention The cell possessing a hydrogen ion conductive polymer electrolyte membrane and the electrode of the pair arranged in the location which sandwiches said hydrogen ion conductive polymer film In the polyelectrolyte mold fuel cell which carried out supply discharge of the fuel gas which contains hydrogen in one side of said electrode, and carried out the laminating through the conductive separator in which the gas circulation way which carries out supply discharge of the oxidizer gas containing oxygen was formed on another side It is characterized by constituting said conductive separator from the ferrite system or the austenite stainless steel plate with which a carbonaceous content does not exceed 0.03 % of the weight.

[0012] As for a stainless steel plate, at this time, it is effective to be 1.5 % of the weight or more, and to have contained Mo 8 or less % of the weight.

[0013] This invention moreover, the cell possessing a hydrogen ion conductive polymer electrolyte membrane and the electrode of the pair arranged in the location which sandwiches said hydrogen ion conductive polymer film In the polyelectrolyte mold fuel cell which carried out supply discharge of the fuel gas which contains hydrogen in one side of said electrode, and carried out the laminating through the conductive separator in which the gas circulation way which carries out supply discharge of the oxidizer gas containing oxygen was formed on another side It is the polyelectrolyte mold fuel cell which a carbonaceous content does not exceed 0.03 % of the weight for said conductive separator, but the content of nitrogen is 0.1 % of the weight or more, and is characterized by constituting from 0.3 or less % of the weight of an austenitic-stainless-steel plate.

[0014] this time — a stainless steel plate — Cr — 18.5 % of the weight or more — and 23 or less % of the weight and nickel — 12 % of the weight or more — and 20 or less % of the weight and Mo — 1.5 % of the weight or more — and it is effective to have contained 8 or less % of the weight.

[0015] Furthermore, it is effective to be 0.05 % of the weight or more, and to have added 0.2 or

less % of the weight of Cu to the stainless steel plate.

[0016] This invention moreover, the cell possessing a hydrogen ion conductive polymer electrolyte membrane and the electrode of the pair arranged in the location which sandwiches said hydrogen ion conductive polymer film In the polyelectrolyte mold fuel cell which carried out supply discharge of the fuel gas which contains hydrogen in one side of said electrode, and carried out the laminating through the conductive separator in which the gas circulation way which carries out supply discharge of the oxidizer gas containing oxygen was formed on another side It is the polyelectrolyte mold fuel cell characterized by constituting said conductive separator from a ferritic-stainless-steel plate which is 18.5 % of the weight or more, and contained Cr 23 or less % of the weight.

[0017] As for a stainless steel plate, at this time, it is effective that a carbonaceous content does not exceed 0.015 % of the weight, and the content of nitrogen does not exceed 0.015 % of the weight.

[0018] As for the above stainless steel plate, it is effective to have added Ti or Nb so that $X+Y \geq 8 (Z+W)$, however X, Y, Z and W might become {show weight % of Ti, Nb, carbon, and nitrogen, respectively}.

[0019]

[Embodiment of the Invention] This invention is polyelectrolyte mold fuel cell SU, and, specifically, is to have found out the separator ingredient which maintains high conductivity and the chemical inertness which causes neither corrosion nor the dissolution to the environment where a separator plate is put, the reducing atmosphere by the side of a fuel electrode, the oxidizing atmosphere by the side of an air pole, an ordinary temperature -90 degree C operating temperature, humidification, the high humidity accompanying generation of water, etc. by adjusting a stainless alloy presentation and an alloying element. It is characterized by offering the polyelectrolyte mold fuel cell stack to which generating efficiency does not fall even if it is low cost, and it excels in compactability and it carries out long duration operation by using the separator plate constituted from this stainless steel ingredient.

[0020] A concrete alloy presentation and a concrete alloying element are shown below. Although the carbon contained in stainless steel generates a powerful austenite texture and raises the reinforcement of steel, it deposits chromium carbide in the grain boundary, produces a chromium impoverishment layer, and causes intergranular corrosion. The reinforcement of the steel as a separator plate for polyelectrolyte mold fuel cells is enough even if it does not add carbon, and the carbon content in the stainless steel used for the separator for polyelectrolyte mold fuel cells found out that it was it hard to generate the corrosion of intergranular corrosion etc. under a cell operating environment to be 0.03 or less % of the weight.

[0021] Moreover, in that a deposit of chromium carbide is avoided, although it was also effective to have added Ti which is easy to combine with carbon, and Nb, under the operating environment of a polyelectrolyte mold fuel cell, it found out that it was effective to add Ti or Nb as a separator ingredient so that it may become $\geq (Ti+Nb) 8 (C+N)$ weight %.

[0022] Moreover, it is put near the electrode of a polyelectrolyte mold fuel cell to an acid ambient atmosphere that the polyelectrolyte film makes proton free radicals, such as a sulfonic group, main structure and by including a carbon dioxide in reforming fuel gas. In respect of calling it the acid resistance of a stainless steel ingredient, and sulfuric-acid-proof nature, it is common to add Mo and Cu and it is effective. When acid resistance required as a separator ingredient under the operating environment of a polyelectrolyte mold fuel cell was considered as the saturation of a uniform solid-solution limit community and effectiveness, and ingredient cost, the addition of Mo found out that it was effective to make the addition of 1.5-% of the weight or more 8 or less % of the weight and Cu into 0.2 or less % of the weight 0.05% of the weight or more. Furthermore, it found out that the corrosion resistance under the operating environment of a polyelectrolyte mold fuel cell could be further improved by making Mo and Cu live together.

[0023] Moreover, when nitrogen is added in austenite stainless steel, there is effectiveness which eases the fall of pH by reacting with a hydrogen ion in an acid ambient atmosphere, and generating ammonia. That is, addition of nitrogen is effective in the acid resistance of stainless steel. However, superfluous addition of nitrogen invites aggravation of the workability by

hardening of a stainless steel rope. Then, as a result of considering workability, such as rolling for which the separator ingredient for polyelectrolyte mold fuel cells is asked, and a diaphragm, as the acid-proof improvement by addition of nitrogen, the addition of nitrogen found out that 0.3 or less % of the weight was desirable 0.1% of the weight or more by austenite stainless steel.

[0024] Moreover, if it thinks from viewpoints, such as prevention of the reinforcement of a separator, proof stress, and stress corrosion cracking, it is also very effective to use the stainless steel of a ferrite system. As a result of taking into consideration workability, such as rolling for which the separator ingredient for polyelectrolyte mold fuel cells is asked, and a diaphragm, since workability is a little inferior compared with an austenite stainless steel rope when using the stainless steel of a ferrite system as a separator plate, it found out that the content of nitrogen does not exceed 0.015 % of the weight, and that a carbonaceous content had the desirable thing which do not exceed 0.015 % of the weight and for which things are done.

[0025] Furthermore, corrosion resistance improvement is expectable, so that there are many additions of Cr to the stainless steel rope which is a separator ingredient. However, as a separator ingredient for polyelectrolyte mold fuel cells, the electric resistance and contact resistance of bulk fully need to be small in high corrosion resistance. Although it is fully small as a charge of separator material, if Cr addition is made [many], concerning the electric resistance of bulk the case of a stainless steel rope, contact resistance will increase with growth of a passive state coat layer. Although sufficient corrosion resistance was not acquired, but corrosion resistance improved about Cr content to the stainless steel rope for separator ingredients under the operating environment of a polyelectrolyte mold fuel cell 18 or less % of the weight of the case when it was 24 % of the weight or more, it found out that contact resistance became large too much as a charge of separator material.

[0026]

[Example] Hereafter, the gestalt of operation of this invention is explained, referring to a drawing.

[0027] (Example 1) First, in order to evaluate the corrosion resistance of the stainless steel base material in this invention, the elution test in the sulfuric-acid water solution which uses sample piece was performed. The chemical composition of a sample sample was shown in Table 1. SUS304, SUS310S, SUS316, and SUS316L were used as a comparison sample (Table 1).

[0028]

[Table 1]

基材	化学組成(重量%)						
	Cr	Ni	Mo	Cu	C	N	その他
ステンレスA	19-21	17-19.5	5.5-6.5	0.5-1	≤0.02	0.16-0.24	
ステンレスB	18.5-21.5	13.5-16.5	2.5-3.5	1-2	≤0.03	0.16-0.24	
ステンレスC	18.5-20	-	1.75-2.25	-	≤0.015	≤0.015	Nb: Nb ≥ 8(C+N)
SUS304	18-20	8-10.5	-	-	≤0.08	-	
SUS310S	24-26	19-22	-	-	≤0.08	-	
SUS316	16-18	10-14	2-3	-	≤0.08	-	
SUS316L	16-18	12-15	2-3	-	≤0.03	-	

[0029] The approach of an elution test and conditions processed into disc-like sample piece with a diameter [of 30mm], and a thickness of 5mm the various stainless steel base materials which serve as a sample first, respectively. The sample piece front face was ground by buffing. it being immersed in 100ml of sulfuric-acid water solutions with a concentration of 0.02 Ns, boiling these sample piece with reflux equipment for 100 hours, and carrying out ICP mass analysis of the sulfuric-acid solution after boiling — the elution volume of a metal ion — a quantum — it compared.

[0030] The result is shown in drawing 2 . Thereby, a carbonaceous content did not exceed 0.03 % of the weight, but or more 1.5 weight [or less 8] % content of Mo was done, or more 18.5 weight % content of Cr was done, and it became clear that the ferrite system or the austenite stainless steel which added Ti or Nb so that it might become $\geq (Ti+Nb) 8 (C+N)$ weight % depending on the

case was excellent in corrosion resistance. Moreover, a carbonaceous content did not exceed 0.03 % of the weight, but the content of nitrogen did or more 0.1 weight [or more 0.3] % content of, and it became clear that the austenitic stainless steel which added Cu of or more 0.05 weight [or less 0.2] % depending on the case was excellent in corrosion resistance. Furthermore, it became clear that the ferrite system stainless steel rope with which a carbonaceous content does not exceed 0.015 % of the weight, and the content of nitrogen does not exceed 0.015 % of the weight was excellent in corrosion resistance.

[0031] (Example 2) Next, the stainless steel base material used in the example 1 was processed into isomorphism-like sample piece, it pinched between two carbon paper with a thickness [of the same material as the electrode for polyelectrolyte mold fuel cells] of 400 micrometers, and contact resistance with carbon paper was measured. As the copper plate which gold-plated was installed in the both sides of carbon paper as a charge collector and the load of arbitration could be added for these whole sample to them by the pneumatic cylinder, they were asked for the load dependency of contact resistance.

[0032] The result is shown in drawing 3. As for SUS310S which contain by this Cr which was excellent in corrosion resistance with the example 1 24 to 26% of the weight, it became clear that contact resistance became large too much with growth of a passive state coat. Moreover, it became clear that the sample of contact resistance by this invention is small compared with other stainless steel.

[0033] (Example 3) Next, the stainless steel base material used in the example 1 was processed into the separator plate, respectively, it included in the polyelectrolyte mold fuel cell stack, and the durable cell operation test was performed. Moreover, in this example, the fuel cell stack using the separator plate made from carbon performed the durable cell operation test similarly, and added it as an example of a comparison.

[0034] The creation approach of an electrode is explained first. Particle size was immersed [acid / chloroplatinic acid and / ruthenium chloride] in the water solution which carried out the equimolar dissolution in carbon powder several microns or less, and made carbon powder support a platinum-ruthenium catalyst by reduction processing. It was made to distribute in the alcoholic solution of a polyelectrolyte, and this platinum support carbon powder was slurred.

[0035] On the other hand, after sinking into the aqueosity dispersion of a fluororesin carbon paper with a thickness of 400 micrometers it is thin at the polar-zone base, this was dried and water repellence was given to carbon paper by heat-treating at 400 degrees C for 30 minutes. Next, the above-mentioned slurry was applied to homogeneity, and carried out the catalytic-reaction stratification to one side of water-repellent carbon paper, and it considered as the electrode.

[0036] It is made for the field which equipped the next with the electrode of two sheets and equipped both sides of the polyelectrolyte film with larger ** outside a round than an electrode with the catalytic-reaction layer to face the polyelectrolyte film, respectively, and after carrying out alignment of superposition and the gasket made of silicone rubber to the periphery section further so that it may be located in the center of a polyelectrolyte, the hotpress was carried out for 5 minutes and 100 degrees C (MEA) of electrode electrolyte zygotes were obtained. Furthermore, said MEA was cut in die length of 20cm, and width of face of 10cm.

[0037] 4 cel laminating of the obtained MEA was carried out through the separator plate, and it considered as the fuel cell stack. The separator plate formed the gas passageway with a depth of 1mm in the front face which touches MEA by 3mm in thickness by cutting by width of face of 2mm. Moreover, the cooling water way has been arranged every two cels. The metal end plate made from SUS304 was arranged on the upper part and the lower part of a cell stack, and manifolds 11 and 12 were allotted to the cell stack both-sides side through the insulator 13 and the gasket 10. Supply of the fuel gas which uses hydrogen as a principal component through said manifolds 11 and 12, air, and cooling water, and discharge were performed. The cooling water way 8 was installed every two cels. Drawing of longitudinal section which cut the part to drawing 4 and lacked the perspective view of the cell stack of this example in it was shown in drawing 5.

[0038] The fuel cell stack explained above was produced for every various stainless steel base material separators, and the durable cell operation test was performed to each fuel cell stack, measuring the electrical potential difference of each unit cell. It supplied, after having used air

for the anode side, using the bubbler for the reforming simulation gas (hydrogen 75 volume %, carbon-dioxide 25 volume %, 100 ppm of carbon monoxides), and cathode side, respectively and humidifying, and it operated for 2000 hours on condition that the cell temperature of 75 degrees C, and current density 0.7 A/cm². It considered as 70% of hydrogen utilization factors, 30% of oxygen utilization factors, the anode side bubbler temperature of 75 degrees C, and the cathode side bubbler temperature of 65 degrees C.

[0039] The result is shown in drawing 6. In addition, since initial engine performance sufficient since the cell using the separator by SUS310S has too large contact resistance was not obtained, a durability test was not performed. Thereby, it became clear that the separator for polyelectrolyte mold fuel cells using the stainless steel rope by this example could maintain long duration high performance compared with a separator with the conventional stainless steel rope.

[0040] (Example 4) In order to clarify effectiveness of this invention more, the alloy equivalent to the SUS304 stainless-steel rope to which the content of C was changed every 0.01 % of the weight from 0.01 % of the weight to 0.08 % of the weight was prepared, and the same corrosion resistance test as an example 1 was performed. Consequently, when C content was 0.04% of the weight or more of an alloy to the sum total elution volume of Fe, Cr, and nickel having been 100 or less mg/L when C content was 0.03 or less % of the weight of an alloy, the sum total elution volume of Fe, Cr, and nickel was 200 or more mg/L. Thereby, it became clear that the separator ingredient for polyelectrolyte mold fuel cells by this invention has the high corrosion resistance under the simulation operating environment of a polyelectrolyte mold fuel cell.

[0041] (Example 5) In order to clarify effectiveness of this invention more, changed Mo to the SUS304 stainless-steel rope which contained C 0.03% of the weight, and the alloy of an equivalent presentation for every % of the weight from 1 % of the weight to 10 % of the weight, it was made to contain, and the same corrosion resistance test as an example 1 was performed. consequently, when Mo content is 1 or less % of the weight of an alloy To the sum total elution volumes of Fe, Cr, and nickel having been about 100 mg/L, when Mo content is 2% of the weight or more of an alloy The sum total elution volume of Fe, Cr, and nickel was 80 or less mg/L, it was alike, therefore the sum total elution volume of Fe, Cr, and nickel decreased, and when [whose Mo increases] Mo content was 8 % of the weight, the sum total elution volume of Fe, Cr, and nickel fell to about 50 mg/L. However, when Mo content was 8 % of the weight or more, it became clear that the sum total elution volume of Fe, Cr, and nickel did not decrease to about 50 or less mg/L, and the effectiveness of Mo content was saturated.

[0042] Thereby, it became clear that the separator ingredient for polyelectrolyte mold fuel cells by this invention has the high corrosion resistance under the simulation operating environment of a polyelectrolyte mold fuel cell.

[0043] (Example 6) In order to clarify effectiveness of this invention more, changed N to the SUS304 stainless-steel rope which contained C 0.03% of the weight, and the alloy of an equivalent presentation every 0.1 % of the weight from 0% to 0.5 % of the weight, it was made to contain, and the same corrosion resistance test as an example 1 was performed. Consequently, when N content was 0.1% of the weight or more of an alloy, in the case of the alloy which does not contain N to the sum total elution volume of Fe, Cr, and nickel having been about 50 or less mg/L, the sum total elution volumes of Fe, Cr, and nickel were about 100 mg/L.

[0044] However, in the case of the alloy which contained N 0.4% of the weight or more, it became clear that an alloy became hard too much and rolling, press forming, etc. became very difficult. Thereby, it became clear that workability with it was acquired. [the high and corrosion resistance / ingredient / for polyelectrolyte mold fuel cells / by this invention / separator / under the simulation operating environment of a polyelectrolyte mold fuel cell and] [practical]

[0045] (Example 7) In order to clarify effectiveness of this invention more, the remainder which contained C 0.03% of the weight, and contained Mo for N 3% of the weight 0.3% of the weight added Cr into the SUS304 stainless-steel rope and the alloy of an equivalent presentation, and Cr content made it change for every % of the weight from 18 % of the weight to 25 % of the weight, made it contain, and performed the same corrosion resistance test as an example 1. Consequently, when Cr content was the alloy which is 18 % of the weight, in the case of the alloy which contains Cr 19% of the weight or more to the sum total elution volumes of Fe, Cr, and

nickel having been about 50 mg/L, the sum total elution volumes of Fe, Cr, and nickel were about 20 mg/L. However, in the case of the alloy which contained Cr 24% of the weight or more, it became clear that contact resistance with the carbon paper which is the configuration member of the electrode for polyelectrolyte mold fuel cells became large too much. Thereby, as for the separator ingredient for polyelectrolyte mold fuel cells by this invention, it became clear that comparatively small contact resistance was obtained highly [the corrosion resistance under the simulation operating environment of a polyelectrolyte mold fuel cell].

[0046] (Example 8) in order to clarify effectiveness of this invention more — C — 0.03 % of the weight and N — 0.3 % of the weight and Cr — 20 % of the weight and Mo — 3 % of the weight and nickel — 14 % of the weight and the remainder — changed Cu to the alloy of Fe every 0.05 % of the weight from 0 % of the weight to 0.3 % of the weight, it was made to contain substantially, and the same corrosion resistance test as an example 1 was performed.

[0047] Consequently, when Cu did not contain, in the case of the alloy which contains Cu 0.05% of the weight or more to the sum total elution volumes of Fe, Cr, and nickel having been about 20 mg/L, the sum total elution volumes of Fe, Cr, and nickel were about 10 mg/L. However, in the case of the alloy which contained Cu 0.25% of the weight or more, it became clear that the effectiveness of Cu addition was saturated. Thereby, it became clear that the separator ingredient for polyelectrolyte mold fuel cells by this invention has the high corrosion resistance under the simulation operating environment of a polyelectrolyte mold fuel cell.

[0048] (Example 9) In order to clarify effectiveness of this invention more, change N 0.3% of the weight 0.03% of the weight, changed Cr for every % of the weight from 18 % of the weight to 25 % of the weight, C was made to contain, the ferrite system stainless steel rope of Fe was used for the remainder real target, and the same corrosion resistance test as an example 1 was performed. Consequently, when Cr content was 18 % of the weight, in the case of the alloy which contains Cr 19% of the weight or more to the sum total elution volumes of Fe, Cr, and nickel having been about 300 mg/L, the sum total elution volume of Fe, Cr, and nickel was 100 or less mg/L. Moreover, although the sum total elution volume of Fe, Cr, and nickel decreased with the increment in Cr content, in the case of the alloy which contained Cr 24% of the weight or more, it became clear that contact resistance with the carbon paper which is the configuration member of the electrode for polyelectrolyte mold fuel cells became large too much.

[0049] Thereby, as for the separator ingredient for polyelectrolyte mold fuel cells by this invention, it became clear that comparatively small contact resistance was obtained highly [the corrosion resistance under the simulation operating environment of a polyelectrolyte mold fuel cell]. However, since workability was bad compared with an austenite stainless steel rope, the steel materials in an example 9 of the ferrite system stainless steel rope were ingredients which are a little missing at workability.

[0050] (Example 10) in order to clarify effectiveness of this invention more, C is added so that it may become about N and may become $\geq (Ti+Nb) 8 (C+N)$ weight % about Ti and Nb 0.015% of the weight 0.015% of the weight, Cr is changed for every % of the weight from 18 % of the weight to 25 % of the weight, and it contains — making — the remainder — the same corrosion resistance test as an example 1 was substantially performed using the ferrite system stainless steel rope of Fe. Consequently, when Cr content was 18 % of the weight, in the case of the alloy which contains Cr 19% of the weight or more to the sum total elution volumes of Fe, Cr, and nickel having been about 250 mg/L, the sum total elution volume of Fe, Cr, and nickel was 50 or less mg/L. Moreover, although the sum total elution volume of Fe, Cr, and nickel decreased with the increment in Cr content, in the case of the alloy which contained Cr 24% of the weight or more, it became clear that contact resistance with the carbon paper which is the configuration member of the electrode for polyelectrolyte mold fuel cells became large too much. Moreover, it became clear that the ingredient of this example had the workability of an austenite stainless steel rope and equivalent level.

[0051] It became clear that contact resistance with it was obtained, and the separator ingredient for polyelectrolyte mold fuel cells by this invention was excellent in workability by this. [the high and corrosion resistance under the simulation operating environment of a polyelectrolyte mold fuel cell and] [comparatively small]

[0052]

[Effect of the Invention] By this invention, it is low cost, and excelled in compactability, and offer of the polyelectrolyte mold fuel cell stack to which generating efficiency does not fall by cell operation of long duration, either was enabled.

[Translation done.]

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TECHNICAL FIELD

[Field of the Invention] this invention -- the power source for a portable power source and electric vehicles, and domestic -- cogeneration -- it is related with the polyelectrolyte mold fuel cell of the ordinary temperature actuation mold used for a system etc.

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PRIOR ART

[Description of the Prior Art] A polyelectrolyte mold fuel cell is made to react electrochemically, and makes coincidence generate the electrical and electric equipment and heat with the gas diffusion electrode which has arranged catalyst beds, such as platinum, for fuel gas, such as hydrogen, and oxidation gas, such as air. The general configuration of such a polyelectrolyte fuel cell was shown in drawing 1.

[0003] In drawing 1, the catalytic-reaction layer 12 which uses as a principal component the carbon powder which supported the metal catalyst of a platinum system is stuck and arranged in both sides of the polyelectrolyte film 11 to which a hydrogen ion is conveyed alternatively. Furthermore, in the external surface of a catalyst bed 12, the diffusion layer 13 of a pair which combines gas permeability and conductivity is stuck to this, and is arranged. This diffusion layer 13 and the catalytic-reaction layer 12 constitute an electrode 14. While fixing mechanically the electrode electrolyte membrane zygote (following, MEA) 15 formed in the outside of an electrode 14 by the electrode 14 and the polyelectrolyte film 11, the conductive separator plate 17 in which the gas passageway 16 for carrying away the gas of the water which connected adjoining MEA(s) to the serial electrically mutually, and supplied reactant gas to the electrode further, and was generated by the reaction, or a surplus was formed to one field is arranged.

[0004] Although a gas passageway can also be prepared apart from a separator plate, the method which establishes a slot in the front face of a separator plate, and is made into a gas passageway is common. In the still more above polyelectrolyte mold fuel cell stacks, in order to reduce electric contact resistance with configuration members, such as a separator plate, and in order to maintain the seal nature of fuel gas or oxidizer gas, it is required to bind the whole cell stack tight constantly. For that, it is effective to arrange an end plate to those both ends that accumulated many cells on the one direction, respectively, to fix and bind between both that end plate tight using the member for conclusion, and to apply **.

[0005] Moreover, since a fuel cell generates heat during operation, in order to maintain a cell in the good temperature condition, it is necessary to cool with cooling media, such as cooling water. Usually, although the cooling section which pours a cooling medium every one to 3 cel is inserted between separators, cooling-medium passage is established in the tooth back of a separator, and it considers as the cooling section in many cases. After it piles up these MEA(s) and separators, and the cooling section by turns and they carry out two or more cel laminating, it is the structure of a common layer built cell which this is inserted with an end plate and fixed from both ends with a conclusion bolt through a collecting electrode plate and an electric insulating plate.

[0006] Such a separator plate of a polymer electrolyte fuel cell has high conductivity, and to distributed gas, its gas airtightness is high and it needs to have high corrosion resistance and chemical stability to the environment in a fuel cell stack further. Therefore, the conventional separator plate was constituted from carbon ingredients, such as glassy carbon and expanded graphite, and, cutting in the front face, and in the case of expanded graphite, the gas passageway was also created by molding with a mold.

[0007] However, it replaces with the carbon ingredient used conventionally, and the attempt using metal plates, such as stainless steel, is made in recent years.

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EFFECT OF THE INVENTION

[Effect of the Invention] By this invention, it is low cost, and excelled in compactability, and offer of the polyelectrolyte mold fuel cell stack to which generating efficiency does not fall by cell operation of long duration, either was enabled.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] If a carbon ingredient is used for a separator plate like before, for maintenance of gas airtightness and a mechanical strength, there will be a limitation by making 4mm in thickness into a minimum in general to thin-shape-izing of a separator plate, and to become a failure about mount nature will be considered by the miniaturization pan of a cell stack.

[0009] Furthermore, by the approach by cutting of the conventional carbon plate, it is difficult with the ingredient cost of a carbon plate to reduce the processing cost for cutting this, and the approach using expanded graphite also has high ingredient cost, and is considered to be a failure for utilization. It is very effective to constitute a separator plate from metallic materials, such as stainless steel, to miniaturization of a separator plate, low-cost-izing, and high-intensity-izing. However, by the approach using a metallic material, corrosion and the dissolution of a metal plate take place by operation of long duration. If a metal separator corrodes, the electric resistance of a corrosion part and electric contact resistance will increase, and a cell output will decline.

[0010] Moreover, if a metallicity separator dissolves, the dissolved metal ion will mix in MEA, a trap will be carried out to the ion-exchange site of a polyelectrolyte, the own fall of ion conductivity of a polyelectrolyte and the fall of electrode reaction area will be caused, and a cell output will decline. The technical problem that generating efficiency fell gradually according to these causes about carrying out long duration operation of the polyelectrolyte mold fuel cell using the metal separator which is not equipped with sufficient corrosion resistance occurred.

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MEANS

[Means for Solving the Problem] In order to solve such a technical problem the polyelectrolyte mold fuel cell of this invention The cell possessing a hydrogen ion conductive polymer electrolyte membrane and the electrode of the pair arranged in the location which sandwiches said hydrogen ion conductive polymer film In the polyelectrolyte mold fuel cell which carried out supply discharge of the fuel gas which contains hydrogen in one side of said electrode, and carried out the laminating through the conductive separator in which the gas circulation way which carries out supply discharge of the oxidizer gas containing oxygen was formed on another side It is characterized by constituting said conductive separator from the ferrite system or the austenite stainless steel plate with which a carbonaceous content does not exceed 0.03 % of the weight. [0012] As for a stainless steel plate, at this time, it is effective to be 1.5 % of the weight or more, and to have contained Mo 8 or less % of the weight.

[0013] Moreover, this invention carries out supply discharge of the fuel gas which is characterized by providing the following and which contains hydrogen in one side of said electrode for a cell. In the polyelectrolyte mold fuel cell which carried out the laminating through the conductive separator in which the gas circulation way which carries out supply discharge of the oxidizer gas containing oxygen was formed on another side The polyelectrolyte mold fuel cell which a carbonaceous content does not exceed 0.03 % of the weight for said conductive separator, but the content of nitrogen is 0.1 % of the weight or more, and is characterized by constituting from 0.3 or less % of the weight of an austenitic-stainless-steel plate. Hydrogen ion conductive polymer electrolyte membrane The electrode of the pair arranged in the location which sandwiches said hydrogen ion conductive polymer film

[0014] this time -- a stainless steel plate -- Cr -- 18.5 % of the weight or more -- and 23 or less % of the weight and nickel -- 12 % of the weight or more -- and 20 or less % of the weight and Mo -- 1.5 % of the weight or more -- and it is effective to have contained 8 or less % of the weight.

[0015] Furthermore, it is effective to be 0.05 % of the weight or more, and to have added 0.2 or less % of the weight of Cu to the stainless steel plate.

[0016] Moreover, this invention carries out supply discharge of the fuel gas which is characterized by providing the following and which contains hydrogen in one side of said electrode for a cell. In the polyelectrolyte mold fuel cell which carried out the laminating through the conductive separator in which the gas circulation way which carries out supply discharge of the oxidizer gas containing oxygen was formed on another side The polyelectrolyte mold fuel cell characterized by constituting said conductive separator from a ferritic-stainless-steel plate which is 18.5 % of the weight or more, and contained Cr 23 or less % of the weight. Hydrogen ion conductive polymer electrolyte membrane The electrode of the pair arranged in the location which sandwiches said hydrogen ion conductive polymer film

[0017] As for a stainless steel plate, at this time, it is effective that a carbonaceous content does not exceed 0.015 % of the weight, and the content of nitrogen does not exceed 0.015 % of the weight.

[0018] As for the above stainless steel plate, it is effective to have added Ti or Nb so that $X+Y \geq 8 (Z+W)$, however X, Y, Z and W might become {show weight % of Ti, Nb, carbon, and

nitrogen, respectively].

[0019]

[Embodiment of the Invention] This invention is polyelectrolyte mold fuel cell SU, and, specifically, is to have found out the separator ingredient which maintains high conductivity and the chemical inertness which causes neither corrosion nor the dissolution to the environment where a separator plate is put, the reducing atmosphere by the side of a fuel electrode, the oxidizing atmosphere by the side of an air pole, an ordinary temperature -90 degree C operating temperature, humidification, the high humidity accompanying generation of water, etc. by adjusting a stainless alloy presentation and an alloying element. It is characterized by offering the polyelectrolyte mold fuel cell stack to which generating efficiency does not fall even if it is low cost, and it excels in compactability and it carries out long duration operation by using the separator plate constituted from this stainless steel ingredient.

[0020] A concrete alloy presentation and a concrete alloying element are shown below. Although the carbon contained in stainless steel generates a powerful austenite texture and raises the reinforcement of steel, it deposits chromium carbide in the grain boundary, produces a chromium impoverishment layer, and causes intergranular corrosion. The reinforcement of the steel as a separator plate for polyelectrolyte mold fuel cells is enough even if it does not add carbon, and the carbon content in the stainless steel used for the separator for polyelectrolyte mold fuel cells found out that it was it hard to generate the corrosion of intergranular corrosion etc. under a cell operating environment to be 0.03 or less % of the weight.

[0021] Moreover, in that a deposit of chromium carbide is avoided, although it was also effective to have added Ti which is easy to combine with carbon, and Nb, under the operating environment of a polyelectrolyte mold fuel cell, it found out that it was effective to add Ti or Nb as a separator ingredient so that it may become $\geq (Ti+Nb) / 8 (C+N)$ weight %.

[0022] Moreover, it is put near the electrode of a polyelectrolyte mold fuel cell to an acid ambient atmosphere that the polyelectrolyte film makes proton free radicals, such as a sulfonic group, main structure and by including a carbon dioxide in reforming fuel gas. In respect of calling it the acid resistance of a stainless steel ingredient, and sulfuric-acid-proof nature, it is common to add Mo and Cu and it is effective. When acid resistance required as a separator ingredient under the operating environment of a polyelectrolyte mold fuel cell was considered as the saturation of a uniform solid-solution limit community and effectiveness, and ingredient cost, the addition of Mo found out that it was effective to make the addition of 1.5-% of the weight or more 8 or less % of the weight and Cu into 0.2 or less % of the weight 0.05% of the weight or more. Furthermore, it found out that the corrosion resistance under the operating environment of a polyelectrolyte mold fuel cell could be further improved by making Mo and Cu live together.

[0023] Moreover, when nitrogen is added in austenite stainless steel, there is effectiveness which eases the fall of pH by reacting with a hydrogen ion in an acid ambient atmosphere, and generating ammonia. That is, addition of nitrogen is effective in the acid resistance of stainless steel. However, superfluous addition of nitrogen invites aggravation of the workability by hardening of a stainless steel rope. Then, as a result of considering workability, such as rolling for which the separator ingredient for polyelectrolyte mold fuel cells is asked, and a diaphragm, as the acid-proof improvement by addition of nitrogen, the addition of nitrogen found out that 0.3 or less % of the weight was desirable 0.1% of the weight or more by austenite stainless steel.

[0024] Moreover, if it thinks from viewpoints, such as prevention of the reinforcement of a separator, proof stress, and stress corrosion cracking, it is also very effective to use the stainless steel of a ferrite system. As a result of taking into consideration workability, such as rolling for which the separator ingredient for polyelectrolyte mold fuel cells is asked, and a diaphragm, since workability is a little inferior compared with an austenite stainless steel rope when using the stainless steel of a ferrite system as a separator plate, it found out that the content of nitrogen does not exceed 0.015 % of the weight, and that a carbonaceous content had the desirable thing which do not exceed 0.015 % of the weight and for which things are done.

[0025] Furthermore, corrosion resistance improvement is expectable, so that there are many additions of Cr to the stainless steel rope which is a separator ingredient. However, as a separator ingredient for polyelectrolyte mold fuel cells, the electric resistance and contact

resistance of bulk fully need to be small in high corrosion resistance. Although it is fully small as a charge of separator material, if Cr addition is made [many], concerning the electric resistance of bulk the case of a stainless steel rope, contact resistance will increase with growth of a passive state coat layer. Although sufficient corrosion resistance was not acquired, but corrosion resistance improved about Cr content to the stainless steel rope for separator ingredients under the operating environment of a polyelectrolyte mold fuel cell 18 or less % of the weight of the case when it was 24 % of the weight or more, it found out that contact resistance became large too much as a charge of separator material.

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EXAMPLE

[Example] Hereafter, the gestalt of operation of this invention is explained, referring to a drawing.

[0027] (Example 1) First, in order to evaluate the corrosion resistance of the stainless steel base material in this invention, the elution test in the sulfuric-acid water solution which uses sample piece was performed. The chemical composition of a sample sample was shown in Table 1. SUS304, SUS310S, SUS316, and SUS316L were used as a comparison sample (Table 1).

[0028]

[Table 1]

基材	化学組成(重量%)						
	Cr	Ni	Mo	Cu	C	N	その他
ステンレスA	19-21	17-19.5	5.5-6.5	0.5-1	≤0.02	0.16-0.24	
ステンレスB	18.5-21.5	13.5-16.5	2.5-3.5	1-2	≤0.03	0.16-0.24	
ステンレスC	18.5-20	-	1.75-2.25	-	≤0.015	≤0.015	Nb: Nb ≥ 8(C+N)
SUS304	18-20	8-10.5	-	-	≤0.08	-	
SUS310S	24-26	19-22	-	-	≤0.08	-	
SUS316	16-18	10-14	2-3	-	≤0.08	-	
SUS316L	16-18	12-15	2-3	-	≤0.03	-	

[0029] The approach of an elution test and conditions processed into disc-like sample piece with a diameter [of 30mm], and a thickness of 5mm the various stainless steel base materials which serve as a sample first, respectively. The sample piece front face was ground by buffing. it being immersed in 100ml of sulfuric-acid water solutions with a concentration of 0.02 Ns, boiling these sample piece with reflux equipment for 100 hours, and carrying out ICP mass analysis of the sulfuric-acid solution after boiling — the elution volume of a metal ion — a quantum — it compared.

[0030] The result is shown in drawing 2 . Thereby, a carbonaceous content did not exceed 0.03 % of the weight, but or more 1.5 weight [or less 8] % content of Mo was done, or more 18.5 weight % content of Cr was done, and it became clear that the ferrite system or the austenite stainless steel which added Ti or Nb so that it might become $\geq (Ti+Nb) 8 (C+N)$ weight % depending on the case was excellent in corrosion resistance. Moreover, a carbonaceous content did not exceed 0.03 % of the weight, but the content of nitrogen did or more 0.1 weight [or more 0.3] % content of, and it became clear that the austenitic stainless steel which added Cu of or more 0.05 weight [or less 0.2] % depending on the case was excellent in corrosion resistance. Furthermore, it became clear that the ferrite system stainless steel rope with which a carbonaceous content does not exceed 0.015 % of the weight, and the content of nitrogen does not exceed 0.015 % of the weight was excellent in corrosion resistance.

[0031] (Example 2) Next, the stainless steel base material used in the example 1 was processed into isomorphism-like sample piece, it pinched between two carbon paper with a thickness [of the same material as the electrode for polyelectrolyte mold fuel cells] of 400 micrometers, and contact resistance with carbon paper was measured. As the copper plate which gold-plated was

installed in the both sides of carbon paper as a charge collector and the load of arbitration could be added for these whole sample to them by the pneumatic cylinder, they were asked for the load dependency of contact resistance.

[0032] The result is shown in drawing 3. As for SUS310S which contain by this Cr which was excellent in corrosion resistance with the example 1 24 to 26% of the weight, it became clear that contact resistance became large too much with growth of a passive state coat. Moreover, it became clear that the sample of contact resistance by this invention is small compared with other stainless steel.

[0033] (Example 3) Next, the stainless steel base material used in the example 1 was processed into the separator plate, respectively, it included in the polyelectrolyte mold fuel cell stack, and the durable cell operation test was performed. Moreover, in this example, the fuel cell stack using the separator plate made from carbon performed the durable cell operation test similarly, and added it as an example of a comparison.

[0034] The creation approach of an electrode is explained first. Particle size was immersed [acid / chloroplatinic acid and / ruthenium chloride] in the water solution which carried out the equimolar dissolution in carbon powder several microns or less, and made carbon powder support a platinum-ruthenium catalyst by reduction processing. It was made to distribute in the alcoholic solution of a polyelectrolyte, and this platinum support carbon powder was slurred.

[0035] On the other hand, after sinking into the aqueous dispersion of a fluororesin carbon paper with a thickness of 400 micrometers it is thin at the polar-zone base, this was dried and water repellence was given to carbon paper by heat-treating at 400 degrees C for 30 minutes. Next, the above-mentioned slurry was applied to homogeneity, and carried out the catalytic-reaction stratification to one side of water-repellent carbon paper, and it considered as the electrode.

[0036] It is made for the field which equipped the next with the electrode of two sheets and equipped both sides of the polyelectrolyte film with larger ** outside a round than an electrode with the catalytic-reaction layer to face the polyelectrolyte film, respectively, and after carrying out alignment of superposition and the gasket made of silicone rubber to the periphery section further so that it may be located in the center of a polyelectrolyte, the hotpress was carried out for 5 minutes and 100 degrees C (MEA) of electrode electrolyte zygotes were obtained. Furthermore, said MEA was cut in die length of 20cm, and width of face of 10cm.

[0037] 4 cel laminating of the obtained MEA was carried out through the separator plate, and it considered as the fuel cell stack. The separator plate formed the gas passageway with a depth of 1mm in the front face which touches MEA by 3mm in thickness by cutting by width of face of 2mm. Moreover, the cooling water way has been arranged every two cels. The metal end plate made from SUS304 was arranged on the upper part and the lower part of a cell stack, and manifolds 11 and 12 were allotted to the cell stack both-sides side through the insulator 13 and the gasket 10. Supply of the fuel gas which uses hydrogen as a principal component through said manifolds 11 and 12, air, and cooling water, and discharge were performed. The cooling water way 8 was installed every two cels. Drawing of longitudinal section which cut the part to drawing 4 and lacked the perspective view of the cell stack of this example in it was shown in drawing 5.

[0038] The fuel cell stack explained above was produced for every various stainless steel base material separators, and the durable cell operation test was performed to each fuel cell stack, measuring the electrical potential difference of each unit cell. It supplied, after having used air for the anode side, using the bubbler for the reforming simulation gas (hydrogen 75 volume %, carbon-dioxide 25 volume %, 100 ppm of carbon monoxides), and cathode side, respectively and humidifying, and it operated for 2000 hours on condition that the cell temperature of 75 degrees C, and current density 0.7 A/cm². It considered as 70% of hydrogen utilization factors, 30% of oxygen utilization factors, the anode side bubbler temperature of 75 degrees C, and the cathode side bubbler temperature of 65 degrees C.

[0039] The result is shown in drawing 6. In addition, since initial engine performance sufficient since the cell using the separator by SUS310S has too large contact resistance was not obtained, a durability test was not performed. Thereby, it became clear that the separator for polyelectrolyte mold fuel cells using the stainless steel rope by this example could maintain long duration high performance compared with a separator with the conventional stainless steel rope.

[0040] (Example 4) In order to clarify effectiveness of this invention more, the alloy equivalent to the SUS304 stainless-steel rope to which the content of C was changed every 0.01 % of the weight from 0.01 % of the weight to 0.08 % of the weight was prepared, and the same corrosion resistance test as an example 1 was performed. Consequently, when C content was 0.04% of the weight or more of an alloy to the sum total elution volume of Fe, Cr, and nickel having been 100 or less mg/L when C content was 0.03 or less % of the weight of an alloy, the sum total elution volume of Fe, Cr, and nickel was 200 or more mg/L. Thereby, it became clear that the separator ingredient for polyelectrolyte mold fuel cells by this invention has the high corrosion resistance under the simulation operating environment of a polyelectrolyte mold fuel cell.

[0041] (Example 5) In order to clarify effectiveness of this invention more, changed Mo to the SUS304 stainless-steel rope which contained C 0.03% of the weight, and the alloy of an equivalent presentation for every % of the weight from 1 % of the weight to 10 % of the weight, it was made to contain, and the same corrosion resistance test as an example 1 was performed. consequently, when Mo content is 1 or less % of the weight of an alloy To the sum total elution volumes of Fe, Cr, and nickel having been about 100 mg/L, when Mo content is 2% of the weight or more of an alloy The sum total elution volume of Fe, Cr, and nickel was 80 or less mg/L, it was alike, therefore the sum total elution volume of Fe, Cr, and nickel decreased, and when [whose Mo increases] Mo content was 8 % of the weight, the sum total elution volume of Fe, Cr, and nickel fell to about 50 mg/L. However, when Mo content was 8 % of the weight or more, it became clear that the sum total elution volume of Fe, Cr, and nickel did not decrease to about 50 or less mg/L, and the effectiveness of Mo content was saturated.

[0042] Thereby, it became clear that the separator ingredient for polyelectrolyte mold fuel cells by this invention has the high corrosion resistance under the simulation operating environment of a polyelectrolyte mold fuel cell.

[0043] (Example 6) In order to clarify effectiveness of this invention more, changed N to the SUS304 stainless-steel rope which contained C 0.03% of the weight, and the alloy of an equivalent presentation every 0.1 % of the weight from 0% to 0.5 % of the weight, it was made to contain, and the same corrosion resistance test as an example 1 was performed. Consequently, when N content was 0.1% of the weight or more of an alloy, in the case of the alloy which does not contain N to the sum total elution volume of Fe, Cr, and nickel having been about 50 or less mg/L, the sum total elution volumes of Fe, Cr, and nickel were about 100 mg/L.

[0044] However, in the case of the alloy which contained N 0.4% of the weight or more, it became clear that an alloy became hard too much and rolling, press forming, etc. became very difficult. Thereby, it became clear that workability with it was acquired. [the high and corrosion resistance / ingredient / for polyelectrolyte mold fuel cells / by this invention / separator / under the simulation operating environment of a polyelectrolyte mold fuel cell and] [practical]

[0045] (Example 7) In order to clarify effectiveness of this invention more, the remainder which contained C 0.03% of the weight, and contained Mo for N 3% of the weight 0.3% of the weight added Cr into the SUS304 stainless-steel rope and the alloy of an equivalent presentation, and Cr content made it change for every % of the weight from 18 % of the weight to 25 % of the weight, made it contain, and performed the same corrosion resistance test as an example 1. Consequently, when Cr content was the alloy which is 18 % of the weight, in the case of the alloy which contains Cr 19% of the weight or more to the sum total elution volumes of Fe, Cr, and nickel having been about 50 mg/L, the sum total elution volumes of Fe, Cr, and nickel were about 20 mg/L. However, in the case of the alloy which contained Cr 24% of the weight or more, it became clear that contact resistance with the carbon paper which is the configuration member of the electrode for polyelectrolyte mold fuel cells became large too much. Thereby, as for the separator ingredient for polyelectrolyte mold fuel cells by this invention, it became clear that comparatively small contact resistance was obtained highly [the corrosion resistance under the simulation operating environment of a polyelectrolyte mold fuel cell].

[0046] (Example 8) in order to clarify effectiveness of this invention more — C — 0.03 % of the weight and N — 0.3 % of the weight and Cr — 20 % of the weight and Mo — 3 % of the weight and nickel — 14 % of the weight and the remainder — changed Cu to the alloy of Fe every 0.05 % of the weight from 0 % of the weight to 0.3 % of the weight, it was made to contain

substantially, and the same corrosion resistance test as an example 1 was performed.

[0047] Consequently, when Cu did not contain, in the case of the alloy which contains Cu 0.05% of the weight or more to the sum total elution volumes of Fe, Cr, and nickel having been about 20 mg/L, the sum total elution volumes of Fe, Cr, and nickel were about 10 mg/L. However, in the case of the alloy which contained Cu 0.25% of the weight or more, it became clear that the effectiveness of Cu addition was saturated. Thereby, it became clear that the separator ingredient for polyelectrolyte mold fuel cells by this invention has the high corrosion resistance under the simulation operating environment of a polyelectrolyte mold fuel cell.

[0048] (Example 9) In order to clarify effectiveness of this invention more, change N 0.3% of the weight 0.03% of the weight, changed Cr for every % of the weight from 18 % of the weight to 25 % of the weight, C was made to contain, the ferrite system stainless steel rope of Fe was used for the remainder real target, and the same corrosion resistance test as an example 1 was performed. Consequently, when Cr content was 18 % of the weight, in the case of the alloy which contains Cr 19% of the weight or more to the sum total elution volumes of Fe, Cr, and nickel having been about 300 mg/L, the sum total elution volume of Fe, Cr, and nickel was 100 or less mg/L. Moreover, although the sum total elution volume of Fe, Cr, and nickel decreased with the increment in Cr content, in the case of the alloy which contained Cr 24% of the weight or more, it became clear that contact resistance with the carbon paper which is the configuration member of the electrode for polyelectrolyte mold fuel cells became large too much.

[0049] Thereby, as for the separator ingredient for polyelectrolyte mold fuel cells by this invention, it became clear that comparatively small contact resistance was obtained highly [the corrosion resistance under the simulation operating environment of a polyelectrolyte mold fuel cell]. However, since workability was bad compared with an austenite stainless steel rope, the steel materials in an example 9 of the ferrite system stainless steel rope were ingredients which are a little missing at workability.

[0050] (Example 10) in order to clarify effectiveness of this invention more, C is added so that it may become about N and may become $\geq (Ti+Nb) \ 8 \ (C+N)$ weight % about Ti and Nb 0.015% of the weight 0.015% of the weight, Cr is changed for every % of the weight from 18 % of the weight to 25 % of the weight, and it contains — making — the remainder — the same corrosion resistance test as an example 1, was substantially performed using the ferrite system stainless steel rope of Fe. Consequently, when Cr content was 18 % of the weight, in the case of the alloy which contains Cr 19% of the weight or more to the sum total elution volumes of Fe, Cr, and nickel having been about 250 mg/L, the sum total elution volume of Fe, Cr, and nickel was 50 or less mg/L. Moreover, although the sum total elution volume of Fe, Cr, and nickel decreased with the increment in Cr content, in the case of the alloy which contained Cr 24% of the weight or more, it became clear that contact resistance with the carbon paper which is the configuration member of the electrode for polyelectrolyte mold fuel cells became large too much. Moreover, it became clear that the ingredient of this example had the workability of an austenite stainless steel rope and equivalent level.

[0051] It became clear that contact resistance with it was obtained, and the separator ingredient for polyelectrolyte mold fuel cells by this invention was excellent in workability by this. [the high and corrosion resistance under the simulation operating environment of a polyelectrolyte mold fuel cell and] [comparatively small]

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] The sectional view having shown the configuration which turned off and lacked a part of general polyelectrolyte mold fuel cell

[Drawing 2] Drawing having shown the result of the elution test of the stainless plate which is the component of the 1st example of this invention

[Drawing 3] The perspective view of the fuel cell stack produced in the 2nd example of this invention

[Drawing 4] Some (unit cell) sectional views of the fuel cell stack produced in the 2nd example of this invention

[Drawing 5] Some (unit cell) sectional views of the fuel cell stack produced in the 3rd example of this invention

[Drawing 6] Drawing having shown the result of an endurance-running trial of the polyelectrolyte mold fuel cell of the 2nd example of this invention

[Description of Notations]

- 1 Polyelectrolyte Film
- 2 Catalytic-Reaction Layer
- 3 Gaseous Diffusion Layer
- 4 Electrode
- 5 Electrode Electrolyte Membrane Zygote (MEA)
- 6 Gas Passageway
- 7 Conductive Separator Plate
- 8 Cooling Water Way
- 9 Gasket
- 10 Sealing Compound
- 11 Gas Manifold
- 12 Cooling Water Manifold
- 13 Insulator

[Translation done.]

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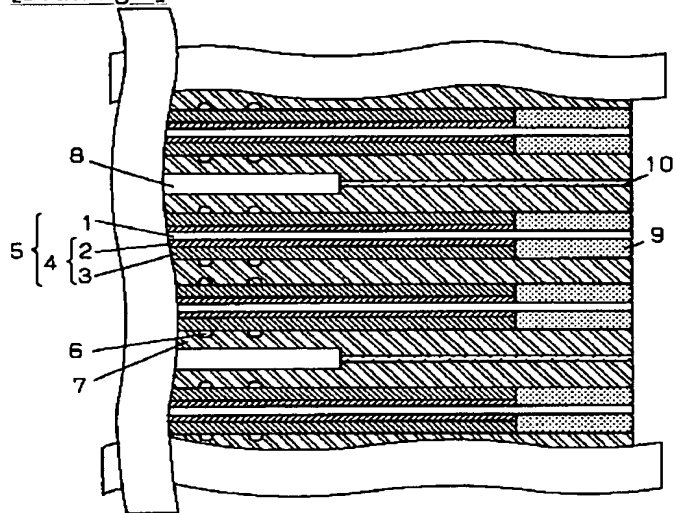
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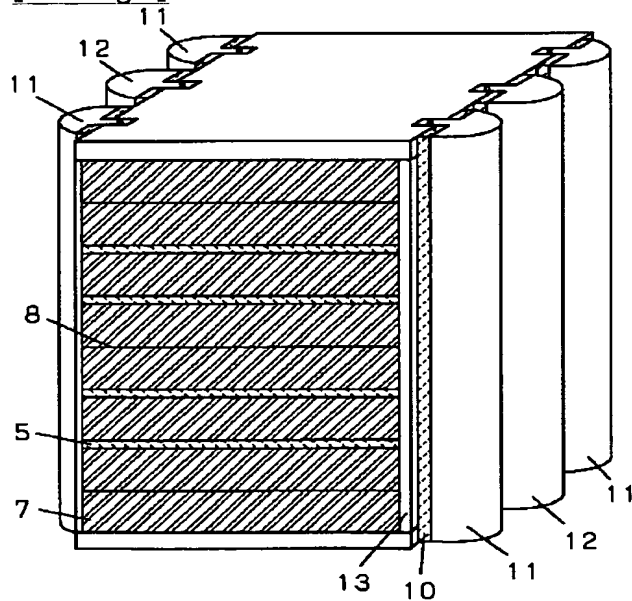
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DRAWINGS

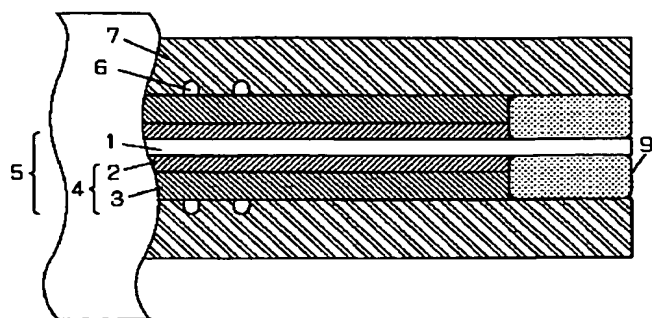
[Drawing 1]



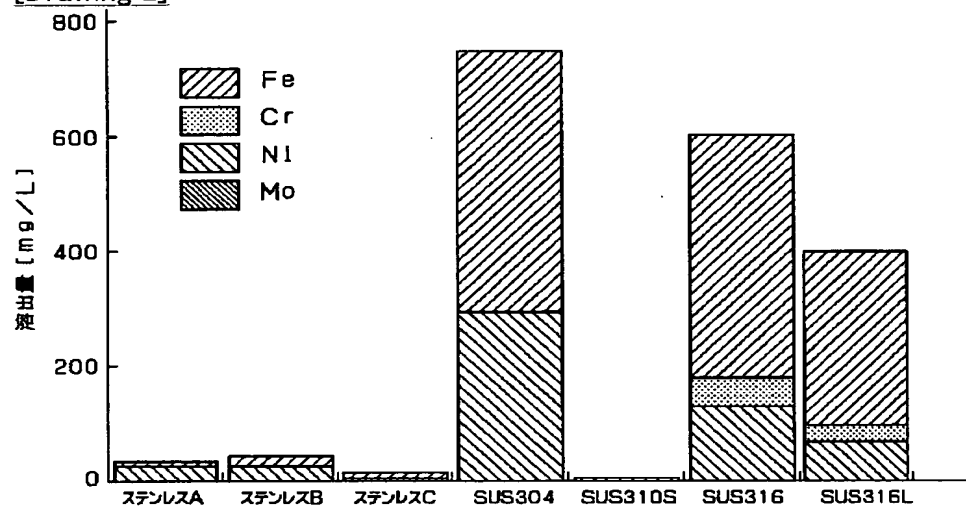
[Drawing 4]



[Drawing 5]



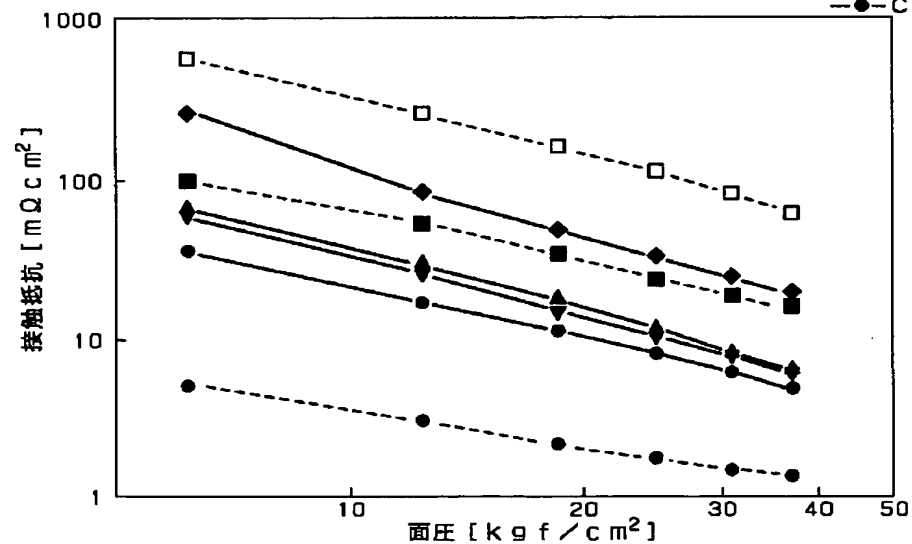
[Drawing 2]



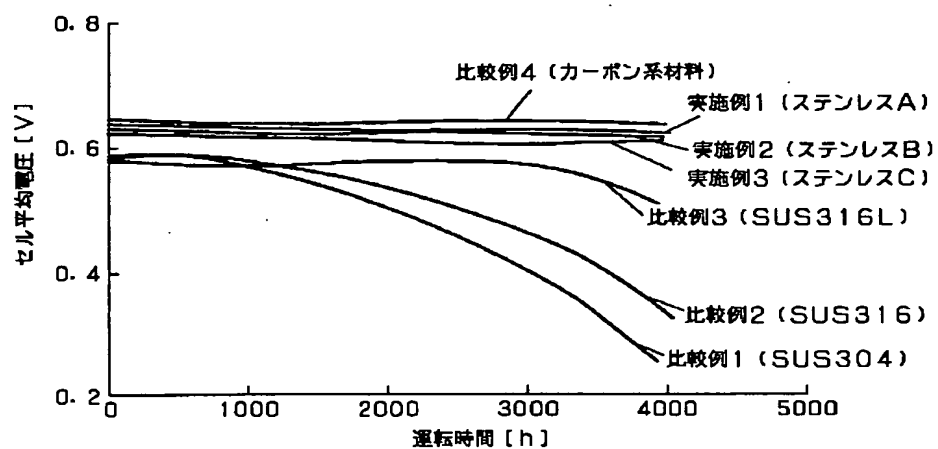
[Drawing 3]

セパレータ基材の接触抵抗

● ステンレスA ■ SUS316L
 ▲ ステンレスB □ SUS310S
 ▼ ステンレスC ◆ SUS304
 ● Carbon



[Drawing 6]



[Translation done.]

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